NO. 14-1746
NO. 15-1390

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

PEI-HERNG HOR,
Plaintiff–Cross-Appellant,
v.

CHING-WU "PAUL" CHU,
Defendant–Appellee,
v.

RULING MENG,
Movant–Appellant.

APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF TEXAS IN CASE NO. 4:08-CV-3584
JUDGE KEITH P. ELLISON

CORRECTED BRIEF OF CROSS-APPELLANT PEI-HERNG HOR

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PEI-HERNG HOR

May 6, 2015

ORAL ARGUMENT REQUESTED

CERTIFICATE OF INTEREST

Counsel for Cross-Appellant, Pei-Herng Hor, certifies the following:

1. The full name of every party or amicus represented by me is:

   Pei-Herng Hor.

2. The name of the real party in interest represented by me is:

   None.

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of the party or amicus curiae represented by me are:

   None.

4. The names of all law firms and the partners or associates that appeared for the party or amicus now represented by me in the trial court or agency or are expected to appear in this court are:

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Date: April 27, 2015

Respectfully submitted,

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TABLE OF CONTENTS

TABLE OF CONTENTS – CONT'D

Page

TABLE OF CONTENTS – CONT'D

Page

TABLE OF AUTHORITIES

CASES

TABLE OF AUTHORITIES – CONT'D

Page

STATUTES

OTHER AUTHORITIES

STATEMENT OF RELATED CASES

This Court previously heard and decided an appeal in this case from the trial court's grant of summary judgment in favor of Chu on the basis of laches and equitable estoppel. This Court affirmed in part, reversed in part, vacated in part and remanded. *See Hor v. Chu*, 699 F.3d 1331 (Fed. Cir. 2012). There are no other related cases.

STATEMENT OF JURISDICTION

The judgment of the district court is final and was entered on August 5, 2014. A00001; Addendum at 1. Cross-Appellant, Pei-Herng Hor moved to amend the findings of fact and conclusions of law. A02602-02611. Appellee, Ching-Wu Chu also moved to amend the findings of fact and conclusions of law. A02612-02616. The district court ruled on both motions, granting and denying requests, and entered its amended findings of fact and conclusions of law on January 21, 2015. A00002-000052. Hor timely filed his notice of appeal on February 19, 2105. A02713-02715.

The district court had exclusive jurisdiction to hear this case pursuant to 28 U.S.C. § 1338(a) because this case is an action to correct inventorship of a patent under 35 U.S.C. § 256.

This Court has jurisdiction over this appeal pursuant to 28 U.S.C § 1295(a)(1).

STATEMENT OF THE ISSUE

Issue

> The district court erred in finding that Hor failed to prove his claim of inventorship under 35 U.S.C. § 256 by clear and convincing evidence. Hor's claim to inventorship of the '866 Patent was supported by corroborating evidence that was sufficient to meet the clear and convincing evidence standard.

STATEMENT OF THE CASE

Cross-Appellant, Pei-Herng Hor, sued Appellee, Ching-Wu Chu, pursuant to 35 U.S.C. § 256 to correct inventorship of two patents: (1) No. 7,056,866 (Superconductivity in Square-Planar Compound Systems) issued on June 6, 2006; and (2) No. 7,709,418 (High Transition Temperature Superconducting Composition) issued on May 4, 2010. A00073-00110; Addendum at 4 and 5. Intervenor, Ruling Meng intervened also seeking to correct inventorship of the patents-in-suit to include her. A00369-00375. Chu moved for summary judgment against Hor and Meng arguing Hor's and Meng's claims of inventorship were barred by the doctrine of laches and also failed for lack of corroboration. A00608. Hor and Meng responded accordingly.

The district court granted Chu's motion for summary judgment based on laches. The court did not decide Chu's motion for summary judgment based on lack

of corroboration. The court *sua sponte* further ruled that Hor's claims were barred by the doctrine of equitable estoppel. A01014-01015. On appeal, this Court reversed in part and vacated in part and remanded. *See Hor v. Chu,* 765 F. Supp. 2d 903 (S.D. Tex. 2011).

On remand, the district court denied all pending dispositive motions and set the case for trial. After trial, the district court issued judgment in favor of Chu. A00001-00002; Addendum at 1. The district court entered findings of fact and conclusions of law in support of its judgment. Hor and Chu both moved for amended findings of fact and conclusions of law. A02602-02659. The district court granted in part and denied in part Hor's motion, granted Chu's motion and issued amended findings of fact and conclusions of law. A00002-000052; Addendum 2 and 3. The court noted that the amended findings and conclusions did not change the ultimate conclusion that Hor had not provided enough corroborating evidence to meet the clear and convincing evidence standard. A00052-00053. The court did not issue a new judgment.

STATEMENT REGARDING ORAL ARGUMENT

Appellant believes that oral argument would aid the Court in deciding this appeal because the scientific and technical issues presented by the facts are complex and the Court may likely have questions regarding some of those issues as well as the facts establishing that Hor proved his claim of inventorship by clear and convincing evidence.

TO THE HONORABLE COURT OF APPEALS FOR THE FEDERAL CIRCUIT:

Appellant, Pei-Herng Hor ("Hor") files his Cross-Appellant's Brief as follows:

I. STATEMENT OF THE FACTS

A. Introduction

Pei-Herng Hor sued to correct inventorship of two patents for a superconductor known as YBCO-123 and other related magnetic rare-earth superconductors. A00111-00124. While at the University of Houston ("UH"), Hor conceived of the primary innovations leading to the creation of YBCO-123 and a related line of magnetic rare-earth superconductors. Ching-Wu "Paul" Chu erroneously obtained patents for these superconductors listing himself as the sole inventor. After an eight day trial, the district court entered judgment in favor of Chu finding that Hor had failed to provide enough corroborating evidence to prove his claim of inventorship by clear and convincing evidence. A00001-00053; Addendum at 1 and 2. Hor appealed and seeks a reversal of the judgment with respect to the magnetic rare-earth superconductors that he conceived of and created.

B. What is Superconductivity?

Superconductivity is a phenomenon occurring in certain materials which is characterized by zero electrical resistance and the exclusion of the interior magnetic field (known as the Meissner Effect). A compound must display both zero

electrical resistance and the Meissner effect to be classified as a superconductor. A02898 and A02907-02908.

Electrical resistance occurs when an electric current is moving through a conductor. Resistance creates heat and results in a loss of voltage. For example, resistance can cause a loss of 30% or more of the electric current flowing through a power transmission line. A02903-02904.

Electrical resistance is measured in ohms. When a compound reaches zero ohms it is superconducting. A02900-02904; A07808. The electrical resistance of a superconductor drops to zero ohms when the material is cooled below its superconducting transition temperature (“T_c”). A02899-02900 and A02904. A superconducting transition occurs between the temperature at which the material begins to display lowered resistance and the temperature at which the material exhibits zero resistance. A02899-02900. A good superconductor has a narrow transition width of no more than a few degrees Kelvin. A02905.

Superconductors with a T_c higher than the boiling point of liquid nitrogen, which is approximately 77°Kelvin (“77K”), are important because liquid nitrogen is readily available for industrial uses. Liquid nitrogen is easier to use and much less expensive than liquid helium and other cooling agents with lower boiling points.

A02906-02907. Superconductors with a T_c above 77K are commonly referred to as High Temperature Superconductors ("HTS").[1] A02899-02900.

C. The Patents-in-Suit

The patents involved in this case are U.S. Patent No. 7,056,866 (the "'866 Patent") issued on June 6, 2006 and U.S. Patent No. 7,709,418 (the "'418 Patent") issued on May 4, 2010.[2] Addendum at 4 and 5. Chu is the only named inventor on both Patents. UH is the assignee of both Patents. A04221 and A07447-07467; Addendum 4 and 5.

D. Dr. Hor's Background

Dr. Hor is an associate professor of physics at UH and is a principal investigator of the Novel Material Research Group at the Texas Center for Superconductivity at UH. ("T_CSUH").[3] A02870. He began studying superconductivity as a graduate student at UH when he decided to become an experimental physicist and joined Chu's research group as a research assistant in 1981 or 1982. The group was known as the High Pressure and Low Temperature laboratory ("HPLT Lab") and focused on researching materials for high-temperature

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[1] 77K is extremely cold by normal standards. 77K is approximately negative 321 degrees Fahrenheit. *See* http://www.aqua-calc.com/convert/temperature/kelvin-to-fahrenheit.

[2] In this appeal, only the '866 Patent is at issue. Addendum at 4.

[3] Dr. Hor has authored or co-authored over 200 published papers. A07468-07478.

superconductivity. Testing materials for superconductivity at extremely low temperatures under high pressure was the HPLT Lab's primary research technique. A02873-02878.

E. <u>Hor Serves as Alternate Principal Investigator of the HPLT Lab</u>

By 1985-1986, Hor was the senior graduate student in the HPLT Lab and assisted in supervising lab activities and training other graduate students. A02878-02879. He was also completing experiments and planning his dissertation. A02886-02887. While working on his dissertation, Chu informed Hor that he had secured him a post-doctoral position at Bell Labs in New Jersey. Hor was excited about this opportunity and planned on beginning working there as a post-doctoral fellow. His salary would have been approximately $39,000. A02888-02889.

Shortly thereafter, Chu informed Hor that the HPLT Lab was having problems with funding from the National Science Foundation ("NSF") and Chu had agreed to take a temporary position at NSF. A02891-02893. Chu asked Hor to remain at UH as the alternate Principal Investigator of the HPLT Lab during Chu's time at NSF to avoid a conflict of interest with NSF. Consequently, Hor was appointed as a visiting assistant professor to serve as alternate Principal Investigator. A02891-02894; A03508 and A03512-03513; A03943; A05853-05854, A05855 and A05856.

Hor agreed to delay going to Bell Labs and stay at UH and serve as alternate Principal Investigator. Hor felt it was his responsibility to help with the funding

problem because the group worked together like a family. A02893-02894; A03908-03909. In fact, the testimony of the witnesses at trial described the work of the HPLT lab as a team or collaborative effort where everyone contributed. The people working in the lab were colleagues and friends with each other. The witnesses have described the working environment in the lab as being like a family.[4] A03189-03190; A03455-03458; A03698.

In September of 1986, Dr. Chu left UH to begin his service as a Program Director at the NSF in Washington, DC. A02897. This full-time position required Chu to be away from UH for part of the time. A02891-02892.

As alternate principal investigator of the HPLT Lab, Hor was responsible for communicating with the Physics Department and was responsible for the business of the group and whatever work was going on in the lab. A02894-02895; A03445. Hor was in effect running the HPLT Lab after Chu started work at NSF. A03219; A03492-03495. Nonetheless, Hor's salary as a graduate assistant was only about $6600 per year. A03907-03908.

[4] It was largely undisputed that the members of the HPLT Lab group worked very well together and that Chu promoted a group spirit. A02879 and A02881. Chu himself displayed the attributes of a typical Chinese mentor in that he was someone who would not only convey knowledge but would also serve as a role model. Chu was like a father figure who Hor and others trusted completely. A02881-02882.

F. Bednorz and Müller Discover the La-Ba-Cu-O Superconductor

In November 1986, Ruling Meng ("Meng"), a material scientist in the HPLT Lab, obtained a paper published by J. Georg Bednorz and K. Alexander Müller describing a La-Ba-Cu-O system (Lanthanum, Barium, Copper and Oxygen) displaying a possible world-record high superconducting T_c. A02908-02910 and A02914; A03180-03183; A04199-04203 and A05061-05065.

After Chu, Hor and Meng reviewed the Bednorz and Müller paper, they attempted to reproduce the La-Ba-Cu-O system.[5] A02912-02913; A03839 and A03900-03901. Meng began synthesizing samples of La-Ba-Cu-O according to the nominal 555 formula mentioned in the Bednorz and Müller article.[6] A04199-04203 and A04271-04291. The group quickly reproduced the Bednorz and Müller result. A02915 and A02919-02920.

G. The HPLT Lab Continues Work on La-Ba-Cu-O

After duplicating Bednorz and Müller's results, Chu directed the HPLT Lab to begin high pressure experiments on their La-Ba-Cu-O samples. The high pressure experiments showed a large increase of T_c. A02923-02925; A03901-

[5] It is a typical research technique to first attempt to reproduce the result of a new scientific report. A02913; A03182-03183.

[6] Bednorz and Müller did not identify the specific composition of superconducting phase of their mixed-phase sample, but rather indicated that the compound was prepared according to a nominal 555 formula – that is a ratio of Barium to Lanthanum to Copper of 5-5-5. A02910-02912; A05061-05065.

03904. This work resulted in a Physical Review Letters[7] paper received on December 15, 1986. Chu was the first author with Hor and Meng listed second and third. A02924-02926; A05857-05859.

Hor's contribution to the work that resulted in the Physical Review Letters publication was clearly documented in a December 15, 1986 memo in which Chu recommended Hor for appointment as a research associate. Hor "has contributed significantly to the understanding and creation of high temperature superconductivity" and that the "discovery of world record, high temperature (>40.2K) superconductivity" was "largely to his [Hor's] credit." A05856; A03907-03908. Shortly thereafter, Hor was appointed as a research associate even though he had not obtained his PhD which is normally a requirement for that position. Hor's salary increased from approximately $550 per month to almost $2000 per month. A02876 and A02926-02927; A03519-03520; A05856.

H. The HPLT Lab Searches for an HTS with a T_c Higher than 77K

During the period from November of 1986 through the next six months, the field of superconductivity research was a very competitive environment. Numerous labs were trying to find out what was going on at UH because of the work

[7] Physical Review Letters was the most prestigious publication at the relevant time. Publishing one or two articles as the first author in Physical Review Letters would secure a faculty position for that person. A02884; A03514.

in development of high-temperature superconductors. A03442-03443. During this time, the notoriety of UH's work made demands on Chu's time. A03444. The Group, however, continued to try new compounds in the search for an HTS with a T_c greater than 77K.

The high pressure result in the Ba-La-Cu-O system achieved by the HPLT Lab was not practical for real world applications. A02929. However, this achievement prompted the HPLT Lab to mimic physical pressure by changing the chemical composition of the La-Ba-Cu-O system through replacement of the larger Barium ions with smaller Strontium and Calcium ions.[8] Work on Strontium and Calcium substitution began in December of 1986. A02928-02932; A03499. Substituting Strontium for Barium increased T_c to about 42K. However, substituting Calcium for Strontium actually decreased T_c. A02931-02933, A03088; A05232-05248 and A05334-05335.

I. <u>Hor Conceives of Yttrium Substitution</u>

In early January 1987, Hor initiated a discussion in his office with Dr. M. K. Wu[9], Meng, and UH graduate student Li Gao regarding where their research should

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[8] Using so-called "chemical substitution" to mimic physical pressure is a well-known technique in the field of high pressure material research. A03063.

[9] Wu was a former UH graduate student who had worked in the HPLT Lab. In 1986, Wu was a faculty member at the University of Alabama in Huntsville ("UA-Huntsville"). A02878 and A02933. Chu had asked Wu to assist in the group's research by substituting Strontium for Barium in the La-Ba-Cu-O system. A02930-

go after Calcium substitution proved to be a dead end. During this discussion, Hor took out a periodic table of the elements in an attempt to identify new substitutions to La-Ba-Cu-O to enhance T_c. At that point, he conceived of the idea of replacing the element Lanthanum with the iso-valent element Yttrium ion. Yttrium replacement was to be made pursuant to a 214 nominal formula.[10] A02933-02935; A03177-03179 and A03187-03188; A03199 and A03251-03252.

Meng suggested that Wu begin work on Yttrium substitution because the HPLT Lab did not have Yttrium in stock; and that while she would order Yttrium as soon as possible she could not immediately order it because UH was in its winter break. It would take her approximately two weeks to get Yttrium oxide.[11] A02932-02936; A03188-03189; A03200.

Hor also asked Meng to record formulas for conducting the Yttrium substitution experiments, which she did on about January 14, 1987. A04209-02933.

[10] The chemical composition of La-Ba-Cu-O was known as "214" for the ratio of Lanthanum and Barium to Copper to Oxygen. Chu learned of the 214 chemical composition of La-Ba-Cu-O from Dr. Kitizawa at the Material Research Society meeting around December 4, 1986. A02821; A03184-03185; A05094-05134. After that, the HPLT began to make samples according to a 214 nominal formula. A02923.

[11] It was not unusual for Meng to order rare earth oxides because of other work the lab was doing. A03206. It was standard procedure for her to keep rare earths in stock. A03207.

04211. This idea resulted in the creation of a YBCO (Yttrium-Barium-Copper-Oxygen) compound (made initially by Wu) that exhibited superconductivity above 77°K. A04221-04237.

Chu was not at the meeting in Hor's office and only learned of it from Hor. A02938; A03884 and A03934. However, Chu has repeatedly confirmed that this meeting took place and used it as evidence of his conception of YBCO to defeat Wu's claim of inventorship in a patent interference proceeding filed by Wu.[12] A04376-04377; A04461; A04546-04547; A05321-05327 and A05328-05333.

J. <u>January 29, 1987 – The First YBCO Superconductor</u>

On January 29, 1987, Wu called Chu and Hor to report he had observed a reproducible resistive superconducting transition above 77K. A02942; A05108. Wu did not tell Chu what the actual compound consisted of. A03933-03934. Chu described the events of that day as follows:

> I received an exciting call from Maw-Kuen [Wu] from UAH at about 5 p.m., on January 29, 1987. He informed me that he and his students, Jim Ashburn and C. J. Torng, had just observed a reversible sharp R-drop [resistivity] starting at 90°K, and finishing at about 77°K in two of their samples. All of us were ecstatic, since stable and reversible superconductivity might finally have been achieved, provided a Meissner effect could be detected. Right before he called me, Maw-Kuen had also phoned Pei-herng [Dr. Hor] about their exciting

[12] The interference proceeding was styled *Maw-Kuen Wu and James R. Ashburn v. Ching Wu Chu*; Patent Interference No. 102,247; Before the Board of Patent Appeals and Interferences. A05407-05432.

> observation. Without divulging information about the elements of their samples, Maw-Kuen told Pei-herng, "We just did what we discussed previously (in Houston in early January)." Pei-herng, Ruling and I reviewed all our previous data and decided to make a few new samples containing the newly arrived Y and Yb oxides.

A05108.

After his conversation with Wu, Chu asked Hor to write down the elements that he and Wu had discussed in Houston. Hor wrote down formulas which included the Yttrium and Scandium substitution for Lanthanum in La-Ba-Cu-O and were based on a nominal 214 composition. Hor's formulas were then recorded by Meng in her laboratory notebook dated January 29, 1987.[13] Chu was apparently trying to duplicate Wu's result before Wu arrived at UH. A02944 and A02951; A03096; A03210-03211; A03935-03939; A04297.

Wu came to Houston on January 30, 1987 with a sample prepared to a nominal 214 formula and with the composition of $Y_{1.2}Ba_{0.8}CuO_4$. The sample was measured for electrical resistivity and Meissner effect. The sample showed reproducible T_c above 77K. Hor measured the Meissner effect which indicated the resistivity transition observed by Wu was a genuine superconducting transition, and that Wu's sample was a superconductor with a T_c above liquid nitrogen temperature. A02951-02952; A05146-05147.

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[13] Chu admits that he did not contribute to the formulas listed on January 29, 1987, but claims that he suggested that Lutetium and Ytterbium be included. A03938.

Wu's sample was a mixed-phase sample consisting of a black phase and a green phase. It was thought that the black phase was the superconducting phase and the green phase was an insulator. A02955; A03920-03921. The HPLT Lab immediately began work on trying to isolate the black phase. A02956-02957; A04656-04854.

As a result of the discovery of the YBCO compound with a T_c above 77K, Chu wrote a paper for publication which was submitted to the Physical Review Letters on February 6, 1987. In this paper, Wu was the first author of the Alabama group and Hor was the first author of the Houston group. A02952-02954; A05091-05093.

K. <u>The Chemical Composition and Structure of YBCO</u>

At the time of the discovery, the exact chemical composition and crystal structure of the YBCO superconductor were not known. The HPLT Lab was not capable of determining the composition and structure of the phases because it did not have X-Ray diffraction equipment. A02966; A03917. As a result, Chu contacted Dr. David Mao at the Carnegie Institution's Geophysical Laboratory in Washington D.C. Mao engaged Dr. Robert Hazen[14] and other colleagues who

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[14] Hazen authored a book which details many of the events leading up to the discovery and identification of YBCO-123. Chu agrees that it is an accurate record of the events that led to the discovery of YBCO. A03962. The book was admitted at trial as P. Ex. 83 but is not included in the Appendix. *See* ROBERT M. HAZEN,

actually determined the exact chemical formula (or stoichiometry) and crystal structure of the YBCO superconductor. A03953; A02967-02968; A03952-03954; A07693, A07695-07696, A07697-07701.

Hazen did not receive a sample of YBCO to begin his work until February 20, 1987. A03956-03957. On February 27, 1987, Hazen first informed Chu of the preliminary results of his team's analysis of the chemical composition of the YBCO sample. A03958. Therefore, throughout most of February of 1987, Chu, Hor and others in the HPLT Lab did not know the actual chemical composition of YBCO-123. A03228.

On March 5, 1987, Hazen first informed Chu of the preliminary results of his team's analysis of the crystal structure of YBCO-123. At that time he was still attempting to solve the structure. Hazen did not finally determine the structure until March 8, 1987, at which time he first wrote up the details of the structure and phase of YBCO-123. A03960-03961; A07707-07708; A05538 and A05539-05548; A07709. The stoichiometry or chemical composition was determined to be $Y_1Ba_2Cu_3O_7$ which is commonly referred to as the 123 phase. The composition consists of a 1-2-3 ratio of Yttrium to Barium to Copper. A02967-02968; A07703-07704, A07720-07721. The crystal structure was determined through a

BREAKTHROUGH: THE RACE FOR THE SUPERCONDUCTOR (1988).

complicated process of x-ray single-crystal diffraction analysis and was determined to be a square-planar structure. A07722-07723.

L. Hor Discovers a Series of Magnetic Rare-Earth Superconductors

After the YBCO 123 structure and chemical composition had been identified, there was no explanation for why the compound was a high-temperature superconductor. Hor continued to perform experiments in an attempt to discover why YBCO-123 was a superconductor with such a high T_c. A02968.

At that time, it was well known among superconductor researchers that substitution of magnetic elements in a superconductor would lower the T_c, a phenomenon known as the "pair-breaking effect." A02968-02969. On or about March 11 or 12, 1987, after the composition and structure of YBCO-123 were known, Hor asked Meng to completely replace Yttrium in YBCO-123 with the magnetic rare-earth element Gadolinium in order to study the pair-breaking effect due to the presence of magnetic ions. A02969-02972 and A03122-03123; A04810-04811. Gadolinium is the most magnetic of the rare-earth elements and therefore, it is the element used to begin "pair breaking" or "magnetic doping" experiments.[15] A02971-02972; A07830.

[15] Physicists working in the field of superconductors would not have substituted magnetic elements into a superconductor expecting to increase T_c. A02968-02969.

When the Gadolinium compound created by Meng was tested for superconductivity on March 15, 1987; it was found to be a superconductor with a T_c around 85-90K, and thus, no "pair breaking" had occurred. A03157-03158. Hor was surprised by the result because he had expected that if the Gadolinium-123 could form, the T_c would have been reduced or even completely suppressed by inclusion of the magnetic element Gadolinium. Instead, the transition temperature was similar to that of YBCO-123. A02978-02979.

Due to the negative result of the magnetic "pair-breaking effect" experiment with the most magnetic rare-earth Gadolinium, Hor conceived the idea that substitution of other magnetic rare-earth elements for Yttrium in the 123-phase would also produce new high temperature superconductors. A02979-02980.

After obtaining the results of the Gadolinium experiment on March 15, Hor asked Meng to perform complete substitution of Yttrium with the other magnetic rare-earth elements in the periodic table, and several new superconductors were discovered. A02981-02987; A03375.

The lab records show that once the result of the Gadolinium experiment was obtained, an entire series of new magnetic rare-earth superconductors was created and tested. The lab records show a surge of activity in calculating formulas, and synthesizing and testing magnetic rare-earth compounds in the 123-phase including compounds formed with the elements Gadolinium (Gd), Cerium (Ce), Terbium (Tb),

Neodymium (Nd), Erbium (Er), Dysprosium (Dy), Holmium (Ho) Ytterbium (Yb) – all starting with the synthesis of $Gd_1Ba_2Cu_3O_7$ on March 15, 1987. A05924-05931.

The lab records show initial calculations of formulas for magnetic rare-earth compounds on March 12, 1987 and afterwards as follows:

March 12, 1987: **CB 701** $Ce_1Ba_2Cu_3O_7$ (H-154);
Gd 901 $Gd_1Ba_2Cu_3O_7$ (H-158)

March 13, 1987: **SmBa 801** $Sm_1Ba_2Cu_3O_7$ (H-157);
Yb-1501 $Yb_1Ba_2Cu_3O_7$ (H-165)

March 15, 1987: **Tb 1001** $Tb_1Ba_2Cu_3O_7$ (H-160);
Nd 1101 $Nd_1Ba_2Cu_3O_7$ (H-161);
Dy 1201 $Dy_1Ba_2Cu_3O_7$ (H-162);
Ho 1301 $Ho_1Ba_2Cu_3O_7$ (H-163);
Er-1401 $Er_1Ba_2Cu_3O_7$ (H-164)

March 16, 1987: **Yb-1501** $Yb_1Ba_2Cu_3O_7$ (H-166).

A05924-05931 (formula numbers in bold followed by chemical composition).

The lab records show synthesis conditions and/or test results for the following 123-phase formulas for rare-earth elements beginning on March 15, 1987:

March 15, 1987: **GB 901**- $Gd_1Ba_2Cu_3O_7$ (H-431)
CB701 - $Ce_1Ba_2Cu_3$O7 (H-440);
Tb 1001 - $Tb_1Ba_2Cu_3O_7$ (H-449;)
1101 - $Nd_1Ba_2Cu_3O_7$ (H-452);
1201 - $Dy_1Ba_2Cu_3O_7$ (H-454);
1301 - $Ho_1Ba_2Cu_3O_7$ (H -457;)
1401 - $Er_1Ba_2Cu_3O_7$ (H-460).

March 16, 1987: **1501** - $Yb_1Ba_2Cu_3O7$ (H 462).

A04953-05008 (reference can also be made to the H numbers shown above).

This synthesis activity resulted in a surge of testing the superconductivity properties of magnetic rare-earth 123-phase on March 15 and 16, 1987 and thereafter. These tests results showed that the magnetic rare-earth compounds were superconducting with T_c ranging from around 70K to 95K:

March 15, 1987: **G[B]901** 3-15-3 (first measurement of $Gd_1Ba_2Cu_3O_7$) resistivity data showed T_c = 95K - 82K (H-1241)

G[B]901 3-15-5 Meissner effect data T_c onset ~ 93K confirmed G[B]901 is a real bulk superconductor (H-1240)

G[B] 901 3-15-3 resistivity data T_c = 93K - 85K confirmed G[B]901 is a reproducible stable superconductor (H-1239);

March 16, 1987: **DN-1101** 3-15-2 (first measurement of $Nd_1Ba_2Cu_3O_7$ superconductor) resistivity data showed a T_c = 89K - 70K (H-1235);

1401 3-16-4 (first measurement of $Er_1Ba_2Cu_3O_7$ superconductor) resistivity data showed a T_c = 94K - 84K (H-1237);

March 25, 1987: **1301** 3-25-4 (first measurement of $Ho_1Ba_2Cu_3O_7$ superconductor) magnetic resistivity data showed a T_c = 93K - 88K (H -1233).

A02988-02991; A05932-05937.

It required a tremendous amount of concentrated work to create and test these new rare-earth superconductors in such short period of time. This sudden surge of synthesis and testing was an anomaly. A02987.

The discovery of the magnetic rare-earth superconductors resulted in a Physical Review Letters paper which was written by Chu on March 16 or 17, 1987 (immediately after Hor's discovery) and published on May 4, 1987. The article only addresses complete substitution of the magnetic rare-earth elements for Yttrium in the 123 phase. For reasons which will become apparent later, it is important to note that the article does not mention anything about partial substitution of the magnetic rare-earth elements for Yttrium and does not mention use of a nominal 214 formula. A02991-02992; A05304-5307.

Hor was listed as the first author of the UH group for all papers submitted to and published in the Physical Review Letters related to the discovery of the magnetic rare-earth superconductors. A03951; A05091-05093, A05304-05307 and A05549-05552. Chu testified that it was urgent to get the paper to Physical Review Letters because he wanted to maintain his position as being first to discover these new high temperature superconductors. Yet, according to Chu, he waited almost a month after he claims he discovered the new line of magnetic rare-earth superconductors to submit the scientific paper revealing that discovery. The paper was submitted only one day after Hor's testing confirmed the new line of magnetic

rare-earth superconductors. A03980-03983, A03962. This was more than three weeks after Chu claimed he conceived of the idea in February. A05304-05307.

Chu confirmed Hor's role in the discovery of this new series of magnetic rare-earth superconductors in a memorandum to Jim Benbrook, the Chairman of UH Physics Department, on October 6, 1992, written to support Hor's bid for promotion and tenure, Chu stated:

> Over the last five years, Pei's contributions to our research on high temperature superconducting (HTS) and related materials have been significant and numerous. I would like to give only a few examples of advances that he has single-handedly made possible. He and colleagues working under his direction discovered the whole series of the so-called 123 compounds $REBa_2Cu_3O_7$ [RE stands for rare-earth] – the most important HTS compound system to date for both scientific study and large-current applications above 77K. The results appeared in the May 1987 issue of [Physical Review Letters] which became the most cited physics paper in 1987 . . . and 1988.

A05301-05303.

Chu acknowledges that he gave credit to Hor for discovery of the magnetic rare-earth superconductors in his recommendation for promotion and tenure. A03985-03989. Attaining tenure is an important event because a professor is guaranteed employment and can pursue his or her research. Awarding tenure is one of the most involved processes at UH. It is critical to accurately represent the accomplishments of the person in the promotion and tenure recommendation letter. If Chu wrote a promotion and tenure letter for Hor, it would be expected that it would

accurately represent Hor's accomplishments. A03258-03259; A03527-03528 and 03542-03543. In fact, Chu admits that he did not lie when giving Hor credit for discovering the magnetic rare-earth based superconductors. A03992.

Chu also credited Hor with the discovery of the magnetic rare-earth superconductors in a paper published in June of 1987 when he wrote:

> In an attempt to identify the active elements giving rise to the 90K superconductivity, Hor, et al. at Houston decided to employ the standard technique of probing the superconductivity by magnetic rare-earth ions. To our great surprise, the 90K superconductivity in YBCO was hardly affected at all even when Y was completely replaced by strongly magnetic rare-earth elements such as Gd, Sm, Eu, etc.

A05255-05259; *see also* A03983-03985.

After Hor conceived of and discovered the magnetic rare-earth superconductors in mid-March of 1987, Chu prepared another continuation-in-part application (U.S. Patent Application No. 07/032,041) on March 26, 1987. This was within about ten days of Hor's work confirming the existence of the magnetic rare-earth superconductors and over a month after Chu claims he conceived of and created those compounds. A03404-03405; A05611-05646.

M. <u>Chu Claims to Have Invented the Magnetic Rare-Earth Superconductors</u>

Chu claims that he began pair breaking experiments in mid-February using magnetic rare-earth elements for partial substitution of Yttrium and that he

discovered the magnetic rare-earth superconductors when performing these pair-breaking experiments.[16] A03962-03964.

The lab records show initial calculations for preparation of compounds with a small fraction[17] replacement of Yttrium by magnetic Gadolinium on February 22 and March 3, 1987. As expected, these calculations use a nominal 214 formula because the 123 chemical composition of YBCO was not yet known. A03966-03969; A04783-04793. The lab records also show formulas for small-fraction substitutions of magnetic rare-earth elements for Lanthanum (not Yttrium) in La-Ba-Cu-O from March 3 through March 6, 1987. A03967-03971; A04784-04794. This documentary evidence is contained in formulas which were written by Y. Q. Wang in one of the lab notebooks. A03227; A04783-04793. But there is no evidence showing the synthesis conditions for any of these compounds or that any such compounds were actually made or tested. A03967 and A03971; A04783. If there are no records showing that these compounds were actually synthesized, it is very likely that they were never created and thus, could not be tested for superconductivity. A03232. During this time, if a compound was created, it was

[16] Chu never told his patent attorney Charles Cox that his alleged idea for Gadolinium substitution was done as part of a pair-breaking experiment. A03584-03585.

[17] Here the small fraction replacement were either 1% or 5%. That is, either 1% or 5% of the Yttrium is replaced by Gadolinium. A04783

tested for superconductivity and likely tested more than once, unless the sample quality was poor. Samples would be tested for both electrical resistance and for Meissner effect. A03232; A03914-03917; A07813-07815. But there are no lab records or test results to confirm that any of Chu's alleged partial substitution magnetic rare-earth compounds were created or were tested for superconductivity.

As noted above, the lab records used by Chu to establish his conception of the magnetic rare-earth line of superconductors use a nominal 214 formula. However, all but one of those formulas (A04783) are dated after Hazen informed Chu of the 123 chemical composition of YBCO on February 27, 1986. A03966-03971; A07703-07704, A07720-07721; A04783-04794. There would be no reason to continue to use a nominal 214 formula after the YBCO-123 formula was known unless they were written down by someone (like Y. Q. Wang) who may have not yet known about the 123 chemical formula.[18] Notably, all of Hor's magnetic rare-earth pair-breaking experiments used a nominal 123 formula. A05924, A05925, A05926, A05927, A05928, A05929 and A05930.

Chu unequivocally testified that he began "pair breaking" experiments with magnetic elements in February of 1987 – well before the chemical composition and

[18] There was no evidence that Chu instructed Wang to either write down these formulas or perform the partial magnetic rare-earth substitution experiments on which Chu based his claim to have created the magnetic rare-earth superconductors.

structure of YBCO was known. But his previously published papers clearly indicate that these experiments were done by Hor and Meng (or the group) only after the crystal structure of YBCO-123 was identified (March 5, 1987). It is clear from these articles, that Chu, at least at one time, repeatedly represented that the pair breaking experiments could not have been done in February and early March and that they were performed after both the chemical composition (YBCO-123) and the structure (square-planar) were determined by Hazen's group. Here is what Chu wrote about the timing of the discovery of the magnetic rare-earth superconductors:

> **Once the structure [of YBCO] was determined**, we decided to probe the role of Y, that we initially (incorrectly, as it turns out) thought was one of the crucial elements for the 90K T_c. by using the conventional technique, i.e. to replace some Y with magnetic rare-earth elements. Pei-herng and Ruling found that, even with a large fraction of Y replaced by magnetic Gd and Eu, no T_c depression at all was detected in contrast to expectation for LTS's.

A05113 (emphasis added).

> **Once the superconducting phase was known (9) as $YBa_2Cu_3O_{6+x}$,** we decided to determine the active components responsible for the superconductivity in the YBCO compounds by replacing Y by rare-earth and other elements. We found (13, 14) a whole new class of superconductors represented by $ABa_2Cu_3O_{6+x}$, where A = trivalent atoms – e.g., Y, La, Nd, Eu, Sm, Gd, Ho, Er, and Lu.

A05334 (emphasis added).

> **With the exact stoichiometry and general structure of the superconducting phase determined**, we immediately replaced Y by the rare-earth elements to examine the role of Y in high-temperature superconductivity. To our great surprise, the complete replacement of

> Y even with the most magnetic Gd does not affect T_c of these compounds. A new class of superconductors . . . above 90K was therefore discovered.

A05355 (emphasis added).

> **Once the structure was determined**, we set out to determine the role of Y in 90K HTS by partial replacement of magnetic rare-earth for Y. We found that, even with a large fraction of Y replaced by Gd and Eu, no T_c-depression was detected, suggesting that Y is electronically isolated from the superconducting carrier system and serves mostly as a stabilizer in the compound. A whole new series of $RBa_2Cu_3O_{7-\partial}$ (R-123) with R =Y, La, Nd, Sm, Eu, Gd, Ho, Er and Lu, with a $T_c \sim 90$ K was quickly synthesized [24] in our first trial.

A05342 (emphasis added).

Chu's writings clearly establish that the pair-breaking work with Gadolinium and the quick synthesis of the other magnetic rare-earth superconductors occurred only after Hazen had given Chu the information on both the chemical formula and general structure of YBCO 123, which would have been after March 5, 1987. A03994-03995. Moreover, in all of Chu's writings on the discovery of the magnetic rare-earth superconductors there is never a mention of doing a partial substitution for Lanthanum in La-Ba-Co-O in the 214 phase. A04013. And, Chu never claimed credit for coming up with the idea of Gadolinium substitution in any of the papers he wrote. A04014.

N. Partial Substitution of Yttrium Could Not Prove the Existence of a New Superconductor

Chu testified that partial substitution of magnetic rare-earth elements in YBCO established that the magnetic rare-earths could form superconductors. A04137-04140. Chu's statement is scientifically incorrect because without complete replacement of Yttrium there is always a possibility that some pure YBCO-123 will be present in the newly synthesized compound and that it will be responsible for the detection of superconductivity. A07838-07839. In February and March of 1987, Chu's group did not have access to equipment and the technical expertise that would have allowed them to analyze the structure and composition of any such samples. A03917-03918; A07830-07832, A04179-04181. Even Chu admitted that he did not know what the compounds in a mixed phase sample would be and that if YBCO-123 was still present in a sample with partial Gadolinium substitution it would show as superconducting when tested. A04180-04182.

O. DuPont Obtains a License from UH

UH licensed the inventions to DuPont. A04212-04213. Chu's share of the DuPont licensing fee was $684,779.70. Chu made the decision to distribute some of these funds to members of the HPLT Lab group. A03854-03855; A04212-04213.

Chu paid Hor $137,000 out of the DuPont money or about 20% of the total funds received by Chu. Meng and Wu also received $137,000. Chu received $239,529.70. No other member of the group received more than $7,050. A03006-03007; A03856-03857; A04212-04213.

P. <u>The Patents Issue – Hor Attempts to Resolve the Dispute</u>

In 1992 or 1993, Hor left the HPLT Lab to work on his own research. In essence, Chu and Hor split into two groups. A03023-03024. After that, Hor and Chu rarely spoke to each other and Chu was absent from UH for long periods of time while serving at foreign universities. A03086.

In early January of 2006, Meng came to Hor's office to apologize for not being truthful about the discovery of YBCO. Meng told Hor that she was going to retire from UH, and that she wanted to apologize to Hor for something. Meng told Hor that although she knew that Hor had come up with the idea of Yttrium substitution, she "went to court" and testified that Chu was the sole inventor. A03024-03025. Meng apologized for making an affidavit stating that Chu had called her in December of 1986 to suggest Yttrium substitution. A03053-03054. Meng also stated that Chu was probably the sole inventor listed on the patent. A03026 and A03054. Meng later verified with John Warren, UH Vice-President for Intellectual Property, that Chu was the sole inventor listed on the patent application and went back to Hor to tell him that they were not listed as co-inventors. This was the first

time Hor had actual knowledge that he was not named as a co-inventor. A03027-03028; A03265-03266.

On June 6, 2006, the '866 Patent issued. A04221-04237; Addendum at 4. Hor attempted to resolve his claims of inventorship for the '866 Patent administratively within UH by filing a grievance pursuant to UH's internal grievance procedures. A03036-03038; A04214-04220. The University Grievance Committee held one informal hearing which Chu did not attend. A03039-03040. After that, the committee recommended that UH form a special grievance committee with particular expertise to hear Hor's grievance. A03045-03046; A05941-05942. Despite repeated requests from Hor, UH administration refused to form another grievance committee, and as a result, refused to allow the grievance process to go forward and no decision on Hor's grievance was reached. A03041-03042; A05943-05944, A05945, A05946, A05947, A05948, A06004, A06005, A06006-06007 and A06008.

After failing to resolve his claims within UH, Hor filed his original complaint on December 5, 2008 seeking to correct inventorship under 35 U.S.C. § 256. A00111-00124.

II. SUMMARY OF THE ARGUMENT

Hor sued to correct inventorship under 35 U.S.C. § 256. As a threshold matter, Hor concedes that the evidence regarding who conceived of Yttrium substitution in La-Ba-Cu-O is mixed and therefore, Hor is not appealing the district court's determination that he did meet his burden to prove inventorship of YBCO-123 by clear and convincing evidence.[19]

Consequently, this appeal concerns only Hor's claim to have invented a related line of superconductors based on the substitution of magnetic rare-earth elements for Yttirum in YBCO-123. The evidence that Hor conceived of this line of magnetic rare-earth superconductors was clear and convincing and the district court erred in holding that he was not a co-inventor of claims 1, 2, 3, 4, 5, 6, 7, 8 and 10 of the '866 Patent. Addendum at 4.

The evidence established, among other things, that Chu's own writings credited Hor with creating the magnetic rare earth superconductors. Chu clearly stated that Hor had invented these superconductors in a letter in support of Hor's promotion and tenure and other writings.

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[19] The '418 Patent is not at issue here because it only relates to YBCO-123. Addendum at 5.

Chu's numerous writings about the history of the discovery of YBCO-123 also support Hor's claim of co-inventorship while contradicting Chu's claim to have invented the magnetic rare earth superconductors. On multiple occasions, Chu wrote that the magnetic rare-earth superconductors were discovered via experiments conducted after the chemical composition and structure of YBCO-123 were determined – exactly as Hor maintained at trial. Yet, at trial, Chu claimed that he discovered the magnetic rare-earth superconductors in mid-February weeks before the composition and structure of YBCO-123 were finally determined in late February and early March. Chu was unable to explain this contradiction.

The contemporaneously created lab records also support Hor's claim to have invented the magnetic rare earth superconductors in March of 1987. The lab records show and surge of activity in synthesizing and testing of the magnetic rare-earth superconductors immediately after Hor's Gadolinium-based pair breaking experiment which resulted in the creation of the first magnetic rare-earth superconductor. This surge in activity also matches Chu's writings about the history of this discovery. But the lab records do not support Chu's version of events. The lab records do not show a similar surge in activity in mid-February. In fact, the lab records do not support a finding that any of the magnetic rare-earth superconductors were either created or definitively tested in February. Moreover, the lab records show that most of Chu's claimed partial substitution of magnetic

rare-earths were done pursuant to a nominal 214 formula in La-Ba-Cu-O. Again, this contradicts Chu's previous writings which state that magnetic rare-earths were completely substituted for Yttrium in YBCO-123 – exactly as Hor maintained.

Chu's claim to have discovered the magnetic rare-earth superconductors by partial substitution of Gadolinium for Yttrium is also suspect. For scientific reasons, a partial substitution of a magnetic rare-earth for Yttrium in YBCO-123 could not confirm that Gadolinium could form a superconductor. Again Chu's testimony at trial was contradicted by his previous writings on the history of the discovery which instead support Hor's claim of co-inventorship.

The timing of Chu's scientific publications and patent applications also corroborates Hor's claim to have invented the magnetic rare-earth superconductors in mid-March. Chu wrote the relevant scientific paper within one or two days after Hor's discovery and more than three weeks after Chu claims he discovered the magnetic rare-earth superconductors. Chu also filed the continuation-in-part patent application for the magnetic rare-earth superconductors within approximately 10 days of Hor's discovery. Chu himself admitted that it was important to submit papers and patent applications as quickly as possible during this time because of the world-wide competition to create new superconductors. Under the undisputed evidence at trial, it was incredible to believe Chu's claim to have waited almost a

month after he claims to have discovered the magnetic rare-earth superconductors to publish a scientific article and file for a patent on those compounds.

Other corroborating evidence consisted of Hor being named the first author on the relevant scientific publications stemming from the discovery of the magnetic rare earth superconductors – a position which connotes significant contribution to the scientific work; and the fact that Chu awarded Hor a significant share of the money received for licensing of the newly created superconductors. Hor's inventive contribution was also corroborated by the testimony of Meng, Forster and Bechtold.

The evidence clearly and convincingly established that Hor should be named as a co-inventor on the '866 Patent and just as strongly established that Chu's version of critical events was not credible.

III. ARGUMENT

A. <u>The Standards of Review for Inventorship and Correction of Inventorship</u>

A district court has jurisdiction to hear claims for the correction of the non-joinder of a co-inventor on a patent provided the non-joinder error occurred without deceptive intent. *See* 35 U.S.C § 256 (permitting correction of inventorship "[w]henever ... through error an inventor is not named in an issued patent and such error arose without any deceptive intention on his part"); *see also, MCV, Inc. v.*

King–Seeley Thermos Co., 870 F.2d 1568, 1571 (Fed. Cir. 1988) (holding that deceptive intent in failing to join an inventor would not permit correction of inventorship under Section 256 and could invalidate the patent).

Inventorship is a question of law that the Court must review without deference to the trial court's judgment. *See Caterpillar, Inc. v. Sturman Indus.*, 387 F.3d 1358, 1376 (Fed. Cir. 2004); *Sewall v. Walters*, 21 F.3d 411, 415 (Fed. Cir. 1994). The Court reviews the underlying findings of fact for clear error. *See Hess v. Advanced Cardiovascular Sys., Inc.*, 106 F.3d 976, 980 (Fed. Cir. 1997).

Inventorship is largely based on conception of the claimed invention. Conception is the formation in the mind of the inventor, of a definite and permanent idea of the complete and operative invention. *Stern v. Trustees of Columbia Univ.*, 434 F.3d 1375, 1378 (Fed. Cir. 2006).

"[T]o be a joint inventor, an individual must make a contribution to the conception of the claimed invention that is not insignificant in quality, when that contribution is measured against the dimension of the full invention." *Fina Oil & Chem. Co. v. Ewen*, 123 F.3d 1466, 1473 (Fed. Cir. 1997). A joint invention is the product of a collaboration between two or more persons working together to solve the problem addressed. *Burroughs Wellcome Co. v. Barr Labs., Inc.*, 40 F.3d 1223, 1227 (Fed. Cir.1994). People may be joint inventors even though they do not physically work on the invention together or at the same time, and even though each

does not make the same type or amount of contribution. 35 U.S.C. § 116. Joint inventorship arises when collaboration or concerted efforts occur, that is, "when the inventors have some open line of communication during or in temporal proximity to their inventive efforts. *Eli Lilly and Co. v. Aradigm Corp.*, 376 F.3d 1352, 1359 (Fed. Cir. 2004). Such joint behavior can include collaboration or working under common direction, or one inventor building on another's report or suggestion at a meeting. *Id.* (quoting *Kimberly-Clark Corp. v. Procter & Gamble Distrib. Co.*, 973 F.2d 911, 917 (Fed. Cir.1992)).

To constitute a joint invention, it is necessary that each of the inventors work on the same subject matter and make some contribution to the inventive thought and to the final result. Each needs to perform but a part of the task if an invention emerges from all of the steps taken together. It is not necessary that the entire inventive concept should occur to each of the joint inventors, or that the two should physically work on the project together. One may do more of the experimental work while the other makes suggestions from time to time. The fact that each of the inventors plays a different role and that the contribution of one may not be as great as that of another does not detract from the fact that the invention is joint if each makes some original contribution, though partial, to the final solution of the problem. *Kimberly-Clark Corp. v. Procter & Gamble Distrib. Co.*, 973 F.2d 911,

916-17 (Fed. Cir.1992) (quoting *Monsanto Co. v. Kamp,* 269 F.Supp. 818, 824 (D.D.C. 1967)).

If a person makes a practical and concrete suggestion that contributes to the invention, he or she is considered a joint inventor. *Ethicon, Inc. v. U.S. Surgical Corp*., 135 F.3d 1456, 1460 (Fed. Cir. 1998). A contribution to one claim is enough. *Id*. Each joint inventor need not make the same type or amount of contribution to the invention. Each joint inventor needs to perform only part of the task which produces the invention. *Id.* If a person supplies the required quantum of inventive contribution, that person does not lose his or her status as a joint inventor just because he used the services, ideas, and aid of others in the process of perfecting the invention. A person is not precluded from being a joint inventor simply because his or her contribution to the collaborative effort is experimental. *Fina Oil & Chem. Co. v. Ewen*, 123 F.3d 1466, 1473 (Fed. Cir. 1977).

Co-inventors need not contribute to the subject matter of every claim of the patent. *Gemstar-TV Guide Int'l, Inc. v. Int'l Trade Comm'n*, 383 F.3d 1352, 1381 (Fed. Cir. 2004). Because co-inventors need not contribute to the subject matter of every claim of the patent, inventorship is determined on a claim-by-claim basis. *Trovan, Ltd. v. Sokymata*, 299 F.3d 1292, 1302 (Fed. Cir. 2002).

A "rule of reason" analysis is applied to determine whether an inventor's testimony has been corroborated, and each corroboration case must be decided on

its own facts to determine whether the evidence as a whole is persuasive and the inventor's story is credible. *Sandt Tech., Ltd. v. Resco Metal and Plastics Corp.*, 264 F.3d 1344, 1350 (Fed. Cir. 2001). The "rule of reason" requires an examination, analysis and evaluation of "all pertinent evidence when weighing the credibility of an inventor's story." *Holmwood v. Sugavanam*, 948 F.2d 1236, 1239 (Fed. Cir. 1991). Documentary or physical evidence made contemporaneously with the inventive process is reliable proof that the inventor's testimony has been corroborated. *Sandt Tech. Ltd.*, 264 F.3d at 1350-51. Circumstantial evidence about the inventive process may also corroborate a person's contribution to the invention. *Id.* at 1351.

In a Section 256 case, "[t]he inventors as named in an issued patent are presumed to be correct." *Hess,* 106 F.3d at 980. The general rule is that a party alleging misjoinder or non-joinder of inventors must prove its case by clear and convincing evidence. *See Id.* (citing *Garrett Corp. v. United States,* 190 Ct.Cl. 858, 422 F.2d 874, 880 (1970)). They must also provide evidence to corroborate the alleged joint inventor's conception. S*ee Ethicon, Inc.,* 135 F.3d at 1461 (holding that "an alleged co-inventor must supply evidence to corroborate his testimony" of conception).

An alleged co-inventor's testimony cannot, standing alone, provide clear and convincing evidence. *Ethicon, Inc.*, 135 F.3d at 1460. Instead, an alleged co-

inventor must supply evidence to corroborate his or her testimony. *Id.* Corroboration may come from any source other than the individual making the claim. In other words, the inventor cannot corroborate his own testimony. There are no limitations on any other witness. Independent corroboration may consist of the testimony of a witness, other than the inventor, to the actual reduction to practice or it may consist of evidence of surrounding facts and circumstances independent of information received from the inventor. *Reese v. Hurst*, 661 F.2d 1222, 1225 (C.C.P.A. 1981), citing *Thurston v. Wulff*, 35. CCPA 794, 801, 164 F.2d 612, 617 (C.C.P.A. 1947); *accord*, *Gortatowsky v. Anwar*, 58 C.C.P.A. 1266, 442 F.2d 970 (C.C.P.A. 1971) and *Miessner v. Hoschke*, 131 F.2d 865 (D.C. App. 1942).

The evaluation of oral statements from other co-inventors and others is based upon the following factors: (i) delay between the event and trial; (ii) interest of witness; (iii) contradiction or impeachment; (iv) corroboration; (v) witnesses' familiarity with details of alleged prior structure; (vi) improbability of prior use considering state of the art; (vii) impact of the invention on the industry; and (viii) relationship between witness and alleged prior user. *In Re Reuter*, 670 F.2d 1015, 1021 (C.C.P.A. 1981); *Juicy Whip, Inc. v. Orange Bang, Inc.*, 292 F.3d 728, 741 (Fed. Cir. 2002). Oral testimony of interested witnesses is admissible to establish corroboration and is evaluated under the *Reuter* factors. *Lacks Indust., Inc. v.*

McKechnie Vehicle Components USA, Inc., 322 F.3d 1335, 1349-50 (Fed. Cir. 2003).

B. <u>The Patent Statute at Issue</u>

Hor sought to be named as an inventor of the patents-in-suit under 35 U.S.C. § 256 which provides that a co-inventor who was omitted from an issued patent may be added as an inventor to the patent by the Court. At the time this case was filed § 256 provided:

> Whenever through error a person is named in an issued patent as the inventor, or through error an inventor is not named in an issued patent and such error arose without any deceptive intention on his part, the Director may, on application of all the parties and assignees, with proof of the facts and such other requirements as may be imposed, issue a certificate correcting such error.
>
> The error of omitting inventors or naming persons who are not inventors shall not invalidate the patent in which such error occurred if it can be corrected as provided in this section. The court before which such matter is called in question may order correction of the patent on notice and hearing of all parties concerned and the Director shall issue a certificate accordingly.

This provision, enacted in 1952, is remedial in nature. Prior to its enactment, if an inventor was erroneously named or excluded in an issued patent, the only mechanism to correct the error was to invalidate the patent. *See, e.g.*, *Pannu v. Iolab Corp.*, 155 F.3d 1344, 1350 (Fed. Cir. 1998). Section 256 has been characterized by this Court as a "savings provision"; it allows the correction of the patent instead of automatic invalidation. *Id.*

C. Hor Proved His Claim to Inventorship by Clear and Convincing Evidence

The district court erred in holding that there was insufficient corroborating evidence to establish by clear and convincing evidence that Hor invented the magnetic rare-earth line of superconductors that are the subject of claims 1 through 15 of the ‘866 Patent. Addendum at 4. The evidence supporting Hor’s claim of inventorship was almost overwhelming. Moreover, Chu’s claim to have invented the magnetic rare-earth superconductors was not supported by the evidence. Rather, Chu’s story was full of inconsistencies and contradictions.

1. Chu’s Own Writings Credited Hor With Creating the Magnetic Rare-Earth Superconductors.

Chu’s own writings corroborated Hor’s claim to have created the magnetic rare-earth superconductors in March of 1987. First, in his letter of recommendation dated October 6, 1992 in support of Hor’s promotion and tenure at UH, Chu wrote that Hor had “single-handedly” made possible the discovery of “the whole series of the so-called 123 compounds $REBa_2Cu_3O_7$ [RE stands for rare-earth] – the most important HTS compound system to date for both scientific study and large-current applications above 77.” A05301-05303. Second, Chu also gave credit to Hor for initiating the “pair breaking” experiments that led to the discovery of the magnetic rare-earth superconductors. In June of 1987, just months after the discovery, Chu wrote that in “an attempt to identify the active elements giving rise to the 90K

superconductivity, Hor, et al. at Houston decided to employ the standard technique of probing the superconductivity by magnetic rare-earth ions." A05255-05259; *see also* A03983-03985. Thus, when the events clearly were fresh in his mind, Chu correctly gave credit to Hor for having started the pair-breaking experiments that led to the discovery of the magnetic rare-earth superconductors.

2. Chu's Writings Also Contradict His Claim to Have Discovered the Magnetic Rare-Earth Superconductors in February of 1987.

Chu's own published writings clearly contradict his claim to have discovered the line of magnetic rare-earth superconductors earlier in February before Hazen's group had worked out the chemical composition and general structure of YBCO-123. All of Chu's writings in this regard are completely inconsistent with his story at trial but support Hor's version of the events leading up to the discovery of the magnetic rare-earth superconductors. His previously published papers all clearly indicate that the pair breaking experiments were done only after the crystal structure of YBCO-123 was identified (March 5, 1987). It is clear from these articles, that over the years, Chu consistently represented that the pair breaking experiments could not have been done in February or early March and that they were performed after both the chemical composition (YBCO-123) and the structure (square-planar) were determined by Hazen's group As detailed in the Statement of Facts, Chu himself made this claim in at least four articles and papers which were published in various

scientific journals or presented at conferences from 1987 to 1996. These claims were made in the following articles:

> C. W. Chu, et al (including Pei, Meng, Gao, Wang, Huang and Bechtold), *Discovery and Physics of Superconductivity above 90 K*, Presented in the International Workshop on Novel Mechanisms of Superconductivity, June 22-26, 1987, Berkeley, CA. (From: Novel Superconductivity, edited by S. Wolf and V. Kresin (Plenum Publishing 1987) A05351-005367 ("With the exact stoichiometry and general structure of the superconducting phase determined, we immediately replaced Y by the rare-earth elements to examine the role of Y in high-temperature superconductivity.") A05355;
>
> C. W. Chu, *Superconductivity above 90 K*, Proc. Natl. Acad. Sci. (July 1987) pp 4681-4682. Note: Presented on March 23-24, 1987 at Interfaces and Thin Films Symposium at NAS - Washington DC. A05334-05335 ("Once the superconducting phase was known as $YBa_2Cu_3O_{6+x}$. we decided to determine the active components responsible for the superconductivity in the YBCO compounds by replacing Y by rare-earth and other elements.") A05334;
>
> C. W. Chu, *High Temperature Superconductivity*, from H. Newman and T. Ypsilantis (Eds.) History of Original Ideas and Basic Discoveries in Particle Physics (Proceedings of a NATO Advanced Workshop held July 27- August 4 1994 in Erice, Italy) (1996 Plenum Press) pp. 793-836 A05094-05134 ("Once the structure [of YBCO-123] was determined, we decided to probe the role of Y") A05113; and
>
> C. W. Chu, *Superconductivity Above 90 K and Beyond*, Proceedings of the 10th Anniversary HTS Workshop on Physics, Material and Applications, pp. 17-31 (1996) A05336-05350 ("Once the structure was determined, we set out to determine the role of Y in 90K HTS by partial replacement of magnetic rare-earth for Y.") A05342.

Chu had no explanation for why his numerous published accounts that supported Hor's conception of the magnetic rare-earth superconductors in March of 1987 (through pair breaking experiments started with Gadolinium after Hazen's group

completed its work identifying the chemical composition and structure of YBCO-123) were completely inconsistent with his claim at trial to have initiated these experiments and discovered this line of superconductors in February (well before Hazen's group completed its work). Simply put, Chu's own writings corroborated Hor's claim of inventorship of the magnetic rare-earth superconductors in mid-March of 1987 and contradicted Chu's claim at trial to have invented them in February.[20] Corroborating evidence from the opposing party should be considered as is especially convincing.

3. The Lab Records Corroborate Hor Having Created the Magnetic Rare-Earth Superconductors.

As noted, Hor claimed to have discovered and conceived of the entire line of magnetic rare-earth superconductors in mid-March of 1987 when he began pair-breaking experiments substituting the most magnetic Gadolinium for Yttrium in YBCO-123. And as set forth in detail in the Statement of Facts, the lab records show the contemporaneous synthesis and testing of the magnetic rare-earth superconducting compounds in mid-March of 1987 – the exact same time which Hor

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[20] It should also be noted, that Chu's published articles consistently talk about replacing Yttrium in YBCO-123 when doing the pair breaking experiments. As shown, below this is important in analyzing the lab records for the evidence corroborating Hor's claim to have invented the magnetic rare-earth superconductors.

claims to have invented the magnetic rare-earth superconductors after discovering that substitution of Gadolinium for Yttrium in YBCO-123 did not suppress T_c.

The lab records show that once Hor knew the surprising result of the Gadolinium pair breaking experiment, an entire series of new magnetic rare-earth superconductors was almost immediately both synthesized and tested. The lab records clearly show the rapid creation of new magnetic rare-earth compounds in the 123-phase (including substituting the elements Gadolinium (Gd), Cerium (Ce), Terbium (Tb), Neodymium (Nd), Erbium (Er), Dysprosium (Dy), Holmium (Ho) Ytterbium (Yb) for Yttrium in YBCO-123) immediately after the synthesis and testing of $Gd_1Ba_2Cu_3O_7$ on March 15, 1987. A05924, A05925, A05926, A05927, A05928, A05929, A05930 and A05931.

This clearly documented synthesis activity was accompanied by a surge in testing the superconductivity properties of magnetic rare-earth compounds on March 15 and 16, 1987 and shortly thereafter. A02988-02991; A05932, A05933, A05934, A05935, A05936 and A05937.

This surge of activity in calculating formulas, and synthesizing and testing of new compounds was unprecedented and can only logically be explained by Hor's discovery of the Gadolinium-based superconductor. A02987. As shown below, there was no comparable surge of activity or even lab records which supported Chu's claim to have discovered and conceived of the magnetic rare-earth superconductors

earlier in February of 1987. Thus, the contemporaneously located documents support Hor's claim of co-inventorship. *See Sandt Tech. Ltd.*, 264 F.3d at 1350-51.

4. Lab Records Do Not Support Chu's Claim to Have Conceived of the Magnetic Rare-Earth Superconductors Before Hor.

Chu claims that he discovered and created the magnetic rare-earth superconductors in February of 1987. But the lab records clearly do not back up Chu's claims and again contradict his earlier published accounts.

First, the lab records only show one possible variety of magnetic rare-earth compound that was actually created in February. On February 22 and March 3, 1987, the lab records show calculations for preparation of compounds with a small fraction replacement of Yttrium by magnetic Gadolinium using a nominal 214 formula. A03966-03969; A04783-04793. Hor concedes that it is possible that a compound with a small fraction substitution of Gadolinium for Yttrium was actually created – and even possibly created at the direction of Chu – although the lab records do not support that. However, there is a problem that occurs when only a very small percentage of Yttrium is substituted with Gadolinium. If you make a partial substitution of Gadolinium for Yttrium in a mixed phase sample, there is the possibility that the resulting sample will still contain YBCO-123. When tested, the presence of YBCO-123 would show the sample to be superconducting. A02972; A03971-03974. In February and March of 1987, the HPLT Lab did not have the

capability of performing x-ray diffraction analysis to identify which compounds were in a mixed phase sample. Without such analysis, the lab could not tell if Gadolinium was completely substituted into the 123 phase or if the compound still contained YBCO-123. For these reasons, partial substitution of Gadolinium for Yttrium in the 214 phase would have been scientifically meaningless and could not have formed the basis for the discovery of the magnetic rare-earth superconductors. A02973, A03137-03140 and A03175; A03353-03355; A03975-03977. That only occurred when Hor performed his experiments later in March in which Gadolinium was completely substituted for Yttrium in YBCO-123. Since there was no Yttrium in those samples there could not have been any YBCO-123; and thus, superconductivity had to be the result of a Gadolinium-based compound.

Chu also points to other lab records showing formulas for small fraction substitution of other magnetic rare-earths for Lanthanum (not Yttrium) in La-Ba-Cu-O using a nominal 214 composition. A04784-04793. This presents another problem for Chu because there is absolutely no evidence in the lab records showing that these compounds were ever actually synthesized or tested for superconductivity. A03967 and A03971; A04976. If there are no records showing that these compounds were actually synthesized, it is very possible that they were never created. A03232. And in fact, there are no records showing synthesis conditions for Chu's alleged pair-breaking experiments. During this time, if a compound was

created it was tested for superconductivity and likely tested more than once, unless the sample quality was poor. Samples would be tested for electrical resistance and for Meissner effect. A03232; A03914-03917; A07813-07815. But there are no testing records for any of the magnetic rare-earth compounds that Chu claims to have created – with the possible exception of one record showing testing of a small fraction Gadolinium substitution. However, as shown above, small fraction substitutions of magnetic rare-earths for Yttrium or Lanthanum were scientifically meaningless at the time because of the HPLT Lab's limited ability to analyze mixed phase samples. Thus, the mere existence of a lab record showing a possible formula does not establish that Chu conceived of or created the entire line of magnetic rare-earth superconductors that Hor actually created later in mid-March and for which there is actual documentation of creation and testing for superconductivity in the lab records.

And there are still more problems with Chu's story. As noted, the lab records from March 3 through March 6, 1987 (which were relied on by Chu to establish his conception of the magnetic rare-earth line of superconductors prior to Hor) show formulas for small-fraction substitutions of various magnetic rare-earth elements for Lanthanum in La-Ba-Cu-O using 214 nominal formulas. A04784-04793. But these lab records are dated after Hazen informed Chu of the 123 chemical composition of YBCO on February 27, 1986. A03966-03971; A07703-07704,

A07720-07721; A04783-04793. Once the YBCO-123 formula was known, there would be no logical reason to continue to use a nominal 214 formula unless the person writing down the formulas in the lab records (Y.Q. Wang) did not know about Hazen's work.

Hor recognizes that Chu had no burden to establish that he actually conceived of and created the magnetic rare-earth superconductors. But the very flimsiness and incredible nature of the story Chu related at trial is telling. Simply put, there was no evidence to back up Chu's claim to have created the magnetic rare-earth superconductors prior to Hor. The fact that Chu could not have been the inventor itself, corroborates Hor as the inventor of those superconductors because Hor was the only other advanced physicist in the HPLT Lab and was the Alternate Principal Investigator of the lab during the relevant time. If Chu did not conceive of and create the magnetic rare-earth superconductors, only Hor had the knowledge and experience to do so. *See, e.g., Hess*, 106 F.3d at 98-981 (district court did not err in finding alleged co-inventor was not an inventor where he was totally unfamiliar with the technology involved). What seems painfully obvious is that Chu combed through the lab records in an attempt to find anything that would support his story that he was the inventor of the magnetic rare-earth superconductors. Unfortunately for him, the lab records and his own previous publications are completely inconsistent with the story he told at trial. But, as demonstrated, the lab records and

Chu's own writings absolutely corroborate Hor's claim to have invented the magnetic rare-earth superconductors in March of 1987.

5. The Timing of Chu's Publications and Patent Applications Corroborates Hor Having Conceived of and Created the Magnetic Rare-Earth Superconductors.

It was undisputed that Chu typically drafted papers to be submitted for publication by the HPLT group because he wrote very quickly and that allowed other members of the group to focus on the work. A02964; A03874-03875. Chu himself admitted that during the relevant time in early 1987, it was important to get proposed articles to the publisher as quickly as possible because of concerns that some other group might duplicate the HPLT Lab's results. A03877.

Here, the evidence conclusively established that Chu prepared and submitted the Physical Review Letters paper documenting the discovery of the magnetic rare-earth superconductors within one or two days after Hor discovered the magnetic rare-earth superconductors. Chu wrote and submitted the Physical Review Letters paper on or about March 16, 1987, which was almost immediately after the successful test results from Hor's pair-breaking experiments with Gadolinium and the resultant surge in activity of creating and testing magnetic rare-earth superconductors. Hor was listed as the first author on the paper. Interestingly, the article only addresses complete substitution of the magnetic rare-earth elements for Yttrium in the 123 phase – there is no mention of Chu's claimed partial substitution

of the magnetic rare-earth elements for Yttrium and no mention of Chu's claimed partial substitution of magnetic rare-earth elements for Lanthanum in La-Ba-Cu-O-214. A02991-02992; A05304-05307. Thus, the contemporaneously created article completely corroborates Hor's claim to have conceived of and created the magnetic rare-earth superconductors and further discredits Chu's story. *See Sandt Tech. Ltd.*, 264 F3d at 1350-51. And as noted, Chu testified that it was urgent to get the paper to Physical Review Letters because he wanted to maintain his position as being first to discover these new high temperature superconductors. Yet if Chu's story is to be believed, he waited three weeks after he claims he discovered the new line of magnetic rare-earth superconductors to submit the scientific paper regarding that discovery. Instead, the paper was submitted only one day after Hor tested the new line of magnetic rare-earth superconductors. A03980-03983.

Hor's claim of conception is further corroborated by Chu's filing of a continuation-in-part patent application to include the magnetic rare-earth superconductors shortly after Hor's discovery. After Hor conceived of and discovered the magnetic rare-earth superconductors in mid-March of 1987, Chu prepared another continuation-in-part application (U.S. Patent Application No. 07/032,041) on March 26, 1987 to include those compounds. This was within about ten days of Hor's work and over a month after Chu claims he conceived of and created those compounds. A03404-03405; A05611-05646. Given his

demonstrated quickness in filing patent applications, it is unreasonable to infer that Chu would have waited over a month from mid-February to March 26, 1987 to file a continuation-in-part patent application (involving multiple formulations) that included the magnetic rare-earth superconductors. A03129-03130.

6. Hor Was Listed as First Author on All of the Relevant Scientific Publications.

Hor was listed as the first author or first author from the UH group on all of the relevant scientific publications regarding the creation and discovery of YBCO and the magnetic rare-earth superconductors.[21] This position connotes that person made the most important technical and scientific contribution to the work. That is, the first author in a scientific article typically is the person who has most

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[21] The publications were as follows:

M.K.Wu et al, *Superconductivity at 93K in a New Mixed-Phase Y-Ba-Cu-O Compound System*, PHYSICAL REVIEW LETTERS, Vol. 58, No. 9 (2 March 1987) (Hor listed as first author from UH group) A05091-05093;

P.H. Hor, et al, *High-Pressure Study of the New Y-Ba-Cu-O Superconducting Compound System*, PHYSICAL REVIEW LETTERS, Vol. 58, No. 9 (Hor as first author);

R.M. Hazen, et al, Crystallographic description of phases in the Y-Ba-Cu-O superconductor, PHYSICAL REVIEW B, Vol. 35, No. 13 (1 May 1987) (Hor listed as first author from UH group) A05549-05552; and

P.H. Hor, et al, *Superconductivity above 90 K in the Square-Planar Compound System* $ABa_2Cu_3O_{6+x}$ *with A = Y, La, Nd, Sm, Eu, Gd, Ho, Er, and Lu*, PHYSICAL REVIEW LETTERS, Vol. 58, No. 19 (4 May 1987) (Hor as first author) A050304-050307.

significantly or directly contributed to the actual technical information that is contained in the paper. A07709-07710; A03517. Being listed as first author in the academic and scientific community indicates that person has provided the most significant contribution to the scientific discovery. A02883-02884 and A02954; A03451 and A03515-03517. It would be academically dishonest to list a person as first author if they had not significantly contributed to the work. A03451. Hazen testified that Hor was listed as the first author because Chu was acknowledging he made substantive contributions to the discoveries leading to the paper. A07712.

Hor's status as first author on all of the relevant scientific papers is further corroboration through contemporaneously created documents of the important inventive contributions that he made in the discovery of YBCO-123 and the magnetic rare-earth superconductors.

7. Hor Received $137,000 From Chu's Share of the Licensing Fee for the Patents.

UH licensed the new superconductors to DuPont. Chu received a share of the DuPont licensing fee from UH. Chu made the decision to distribute some of the $684,779.70 to Hor and other members of the HPLT Lab. A03854-03855; A04212-04213. Chu paid Hor $137,000 out of the DuPont money or about 20% of the total funds. Meng and Wu also received $137,000 each. Chu received $239,529.70. No other member of the group received more than $7050. A03006-03007; A03856-

03857; A04212-04213. The total amount paid to Hor, Meng and Wu was approximately 60% of the total of DuPont funds paid by UH to Chu. Chu received approximately 35% of the DuPont funds paid to him by UH. Other persons in the HPLT Lab received the remaining 5% of the DuPont funds. A03857-03858; A04212-04213.

Chu acknowledges that Hor, Meng and Wu made more contributions than the rest of the group. A03858-03859. But the scale of the money paid to Hor is telling. In 1988, Hor's salary at UH was approximately $43,000. A03007. The $137,000 payment was almost three times the amount of his annual salary. A03008. Chu's payment of funds to Hor in such a substantial amount clearly indicates that Hor's contribution to the creation of the patented compounds went well beyond being a "pair of hands." Payment of these funds is further corroboration that Chu himself acknowledged Hor's significant contribution to the inventions.

8. Other Persons Corroborate Hor's Claims.

Hor's inventive contributions to the magnetic rare-earth superconductors was corroborated by other members of the HPLT Lab. Specifically, Meng corroborated Hor's claim that he first suggested complete substitution of Gadolinium in the YBCO-123 phase. According to Meng, after Yttrium was successful, Hor came to her with a "wild idea" to substitute Gadolinium for Yttrium. However, Meng was not familiar with pair-breaking and may not have understood that Gadolinium was

magnetic. A03276-03278; A04810-04811. Meng also confirmed that after obtaining the results of the Gadolinium experiment on March 15, Hor asked Meng to perform complete substitution of Yttrium with the magnetic rare-earth elements in the periodic table. A03375. Similarly, Jeff Bechtold also corroborated that Hor first suggested substitution of Gadolinium in the YBCO-123 phase. A07830-07831, A07831 and A07841. Neither Meng nor Bechtold ever credited Chu with having coming up with the idea for Gadolinium substitution. Ken Forster, a graduate student from another lab who worked with Hor, Meng and Chu, also testified that Dr. Hor and Meng should be named as co-inventors because of their intellectual contributions to the discovery of the patents. A03447-03450; A03459-3460.

Meng's, Forster's and Bechtold's testimony satisfies many of the relevant *Reuter* factors. *See* 670 F.2d at 1021. Neither Meng, Forster nor Bechtold had an interest in seeing Hor named as a co-inventor. Forster's and Bechtold's testimony was neither impeached nor clearly contradicted. As far as their relationship with Hor goes, all of the corroborating witnesses were also clearly familiar with the work in question. In short, there was no reason to discount their testimony. Meng and Bechtold both described Hor as a friend, but the evidence was that the HPLT group operated like a family with Chu as the mentor.

IV. CONCLUSION

Hor proved his claim of inventorship to the relevant claims of the '866 Patent by clear and convincing evidence. When all of the pertinent evidence is evaluated, Hor's inventive contribution to the '866 Patent is clear. *See Trovan*, 299 F.3d at 1302. The district court erred in finding that there was insufficient evidence of corroboration of Hor's inventive contributions. Hor should be named as a co-inventor of the '866 Patent.

For the reasons stated herein, Cross-Appellant Pei-Herng Hor respectfully requests that the Court reverse the judgment of the district court and render judgment in his favor.

Respectfully submitted,

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ADDENDUM

1. Final Judgment (Doc. No. 207)
2. Amended Memorandum and Order (Doc. No. 217)
3. Memorandum and Order (Granting in Part Hor's Motion to Amend Findings and Chu's Motion to Amend Findings) (Doc. No. 216)
4. U.S. Patent No. 7,056,866
5. U.S. Patent No. 7,709,418
6. 35 U.S.C. § 116
7. 35 U.S.C. § 256 (former version)

PROOF OF SERVICE

I hereby certify that Plaintiff–Cross-Appellant's Corrected Brief was filed with the Court using the Court's CM/ECF system which electronically served copies on the following individuals:

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CERTIFICATE OF COMPLIANCE

I certify that this brief complies with the type-volume limitations of FED. R. APP. P. 32(a)(7)(B) because:

1. Excluding the parts of the brief exempted by FED. R. APP. P. 32(a)(7)(B)(iii), the brief contains 11,125 words.

2. The brief complies with the typeface requirements of Fed. R. App. P. 32(a)(5) and the type style requirements of Fed. R. App. P. 32(a)(6) because this brief has been prepared in a proportionally spaced typeface (14 point Times New Roman font) using Word 2013.

April 27, 2015

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